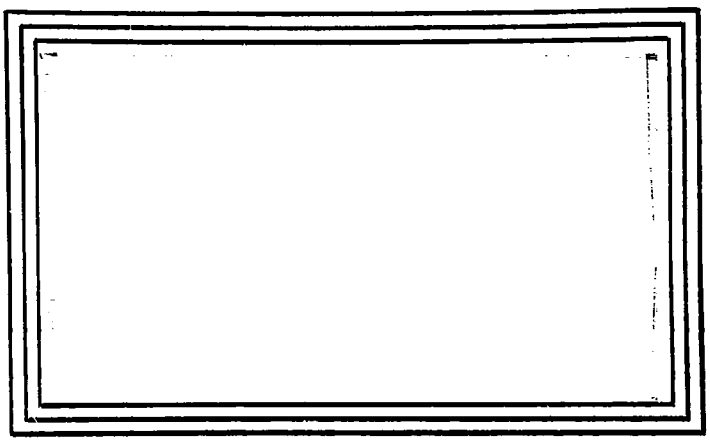
NAVWEPS REPORT



RESEARCH AND DEVELOPMENT DEPARTMENT

U. S. NAVAL AMMUNITION DEPOT – CRANE, INDIANA

NAVWEPS REPORT 5487
14 September 1961

DEVELOPMENT OF THE EX 33 MOD 0 MARINE LOCATION MARKER

Prepared by
E. H. Mason

FOREWORD

The results of the research and development program of the Marine Location Marker, MK 33 Mod 0 are reported here. The development program was assigned to the Research and Development Department, U. S. Naval Ammunition Depot, Crane, Indiana, under direction of Task Assignment RUME 3E 605/323 1/F008-12-001. The task engineer was R. W. Szypulski of the Bureau of Naval Weapons and the project engineers were J. K. Haulotte and E. H. Mason of the Naval Ammunition Depot, Crane, Indiana.

O. N. FOWLER
Captain, USN
Commanding Officer

S. M. FASIG
By direction

ABSTRACT

Development work has been completed on the MK 33 Mod 0 Marine Location Marker. This marker is intended for use with the MK 28 Drill Limpet being developed under contract NOrd 18275. The MK 28 Drill Limpet is intended for UDT use in training exercises against surface vessels. The MK 33 Marine Location Marker provides a visual surface indication, either day or night, of the functioning of the drill limpet. The MK 33 Mod 0 Marine Location Marker produces a green smoke of one minute duration followed by a green flare of one minute duration. A delay is incorporated in the marker to allow time for surfacing of the containing vehicle. This marker has withstood safety handling and environmental evaluation testing. This marker is being further refined and developed under Task Assignment RUME 3E 000/323 1/F008-12-001.

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ILLUSTRATIONS

INTRODUCTION

1. Naval Ammunition Depot, Crane received from the Bureau of Naval Weapons Task Assignment [redacted] 1/F008-12-001 for the development of a pyrotechnic Marine Location Marker. This marker will be used in the EX 28 Drill Limpet being developed by Daystrom, Inc., Poughkeepsie, New York, under contract NOrd 18275. The EX 28 Drill Limpet is intended for use of UDT personnel in training exercises against surface vessels. The EX 33 Marine Location Marker will provide a visual surface indication, day or night, of the functioning of the EX 28 Drill Limpet.

2. The design requirements were as follows:

a. The marker display shall be visible for a minimum of one half mile in sea states up to four.

b. The marker shall consist of a green smoke of one minute duration followed by a green flare of one minute duration.

c. The marker shall have a delay after initiation to allow time for surfacing of the vehicle in which it is contained.

d. It shall be safe and operable after completion of two complete 14-day JAN temperature and humidity cycles of 160°F (95% Relative Humidity) and -65°F.

e. It shall function at temperatures of +27°F to 100°F after exposure to these temperatures for a period of twenty-four hours.

f. It shall be safe but not necessarily operable when dropped from a height of 40 feet.

g. It shall be safe but not necessarily operable after being subjected to standard jolt and jumble tests.

h. It shall be safe and operable after completion of standard transportation vibration tests.

1. It shall withstand an external hydrostatic pressure of 50 psi without leakage.

3. A marker which meets these requirements except requirement e, has been developed. The EX 33 Mod 0 Marine Location Marker produces a green smoke of one minute duration followed by a green flare of one minute duration except when subjected to 28 day T&H Cycle (see para. 20). A delay of approximately 15 seconds is incorporated in the marker to allow time for surfacing of the vehicle in which it is contained. The delay train includes a gasless ignition powder initiated by a "flash" from a primer in the containing vehicle. The powder ignites time fuse fuse to provide the delay. A starter mix is used to ignite the surface of the smoke from the delay train. Pressure buildup from the smoke blows out a seal, releasing the smoke to the atmosphere. A general outline of the unit is shown in Figure III.

DISCUSSION OF THE DEVELOPMENT AND TESTING OF THE ORIGINAL DESIGN

4. In order to arrive at an original design for the marker, discussions were held with representatives of Daystrom, Inc., Poughkeepsie, New York, contractor for the release vehicle, to determine basic dimensions for the marker. Formulations were then established meeting the design requirements for the pyrotechnic display. Packaging hardware was designed within the basic dimensions previously established. The original design is illustrated in Figure I.

TESTING OF THE ORIGINAL DESIGN

5. An evaluation lot of 34 markers was manufactured reflecting the original design. Samples from this lot were subjected to transportation vibration (MIL-STD-303), jumble (MIL-STD-301), jolt (MIL-STD-300), 28 day JAN temperature and humidity cycle (MIL-STD-304), and 40 foot drop (MIL-STD-304). Prior to conditioning, all units were subjected to a vacuum test at 6" Hg for 15 seconds and a hydrostatic pressure test at 50 psi for 30 minutes. Results of the pressure and vacuum test showed that the nose plug seal was not reliable, with

a majority of the signals failing to pass the leakage tests. Evaluation testing was conducted to uncover any other weaknesses in the original design. Static burning times from these tests are summarized in Table 1. Results of the evaluation testing are summarized below:

a. Temperature and Humidity Cycle. Five HX 33 markers in a sealed container were subjected to a 28-day JAN temperature and humidity cycle in accordance with MIL-STD-304. One of these signals functioned properly after the test. The other four signals failed to function as designed. It was determined that the A1A ignition pickup failed to ignite the time fuse delay train.

b. Jumble. Four unpackaged signals were subjected to the jumble test in accordance with MIL-STD-301. On all four markers, the body tube pulled loose from the base at the crimp during the test. The markers were considered safe to handle and dispose of.

c. Jolt. Three markers were subjected to a jolt test in accordance with MIL-STD-300. All signals satisfactorily completed the test; however, two of three failed to function. It was determined that these failures were caused by moisture penetration of the delay assembly during pressure or vacuum testing.

d. Forty Foot Drop. Three markers were subjected to a forty foot drop test in accordance with MIL-STD-302. On all three units, partial separation occurred between the body tube and the base. The markers were considered safe to handle and dispose of.

e. Vibration. Four markers were subjected to a transportation vibration test in accordance with MIL-STD-303. All of the markers successfully completed the test. Three of the four markers functioned properly; the fourth failed to ignite because of moisture penetration of the delay assembly.

6. The following is a summary of deficiencies disclosed in evaluation testing of the original design shown in Figure 1.

a. Failure of the nose plug seal to withstand pressure and vacuum tests without leakage.

b. Separation of the body tube from the base during jumble and drop testing.

c. Unreliable functioning of the delay assembly.

DISCUSSION OF REDESIGNED UNITS

7. Several design changes were made to eliminate the weaknesses disclosed in evaluation testing of the original design. A discussion of these changes follows:

a. The nose plug was replaced with a mechanical seal developed under Contract N164-4532.

b. The body tube was manufactured from 6061T6 aluminum alloy in place of the softer 3003S used in the original design.

c. The delay assembly was modified to provide more reliable ignition of the marker. Two approaches were taken to this problem. The first involved ignition of the time fuse by 6-6-8 starter mix with A1A gasless ignition powder used as the flash pickup. In the second approach, a slurry of F33B gasless ignition powder was used in place of the 6-6-8 starter mix to ignite the time fuse.

d. The base was modified to improve the "o" ring seal between the base and the body tube.

TESTING OF THE REDESIGNED UNITS

8. A second evaluation lot of 34 markers was subjected to the following tests. Burning times from these tests are recorded in Table 2.

9. All units completed vacuum and pressure testing without leakage prior to conditioning.

10. Ambient Firing. Five units were successfully fired at ambient condition.

11. Low Temperature. Five markers were conditioned at 27°F for 24 hours and then fired at this temperature. Functioning of the units was satisfactory.

12. High Temperature. Five markers were conditioned at 100°F for 24 hours and then fired at this temperature. All units were satisfactory.

13. Jolt. Three markers were subjected to jolt testing in accordance with MIL-STD-300. All three functioned at the completion of the test.

14. Jumble. Four unpackaged markers were subjected to jumble testing in accordance with MIL-STD-301. All the markers were safe to handle and functioned at the completion of the test.

15. Forty Foot Drop. Three markers were subjected to forty foot drop testing in accordance with MIL-STD-302. The three markers were safe to handle and functioned properly at the completion of the test.

16. Vibration. Four markers were subjected to transportation vibration testing in accordance with MIL-STD-303. The four markers functioned properly after vibration testing.

17. Temperature and Humidity Cycle. Five markers were subjected to a 28-day temperature and humidity cycle in accordance with MIL-STD-304. The units were placed in an unsealed container with sealing caps over the base of the marker. In addition, twenty delay assemblies slightly modified from the delay assemblies used in the markers were subjected to the temperature and humidity cycle in a sealed container. These modified delays utilized F33B gasless ignition powder to ignite the time fuse in place of the 6-6-8 starter mix used in the delay assemblies in the markers. Four of the five markers did not function at the completion of the test. These failures were caused by failure of the 6-6-8 starter mix to ignite the time fuse. The fifth marker functioned properly except

for accelerated burning of the smoke. All of the delay assemblies which included the F33B gasless ignition powder functioned after completing the temperature and humidity cycle.

18. Field Tests. Tests were conducted at the facilities of Daystrom, Inc., at Poughkeepsie, New York, to determine compatibility of the NAD Crane marker with the release vehicle and to check functioning of the marker in the release vehicle. These tests were considered satisfactory.

19. The results of these tests indicated that the deficiencies disclosed in testing of the original design had been corrected. The final design is illustrated in Figure II.

DISCUSSION

20. Although operation of the markers after JAN temperature and humidity cycle was not completely satisfactory because of the failure of the delay assemblies, it is felt that this condition can be corrected during the PPE program by use of the alternate delay assembly design. This conclusion is supported by successful functioning of these delay assemblies after JAN temperature and humidity testing. Accelerated burning of the smoke composition after temperature and humidity testing, while not desirable, is acceptable since the resulting increased volume of smoke will improve visibility.

21. Overall performance of the EX 33 Mod 0 Marine Location Marker is considered to be satisfactory for release to PPE. This program will be conducted by the Research and Development Department of NAD Crane under Task Assignment RUME 3E 000/323 1/F008-12-001.

TABLE 1

STATIC BURNING TESTS OF ORIGINAL DESIGN

Type of Conditioning	No. of Units Tested	No. of Units Functioning	Average Delay Time (Seconds)	Burning Time (Sec.) Smoke Max.	Smoke Min.	Smoke Avg.	Flare Max.	Flare Min.	Flare Avg.
Ambient Temp.	5	2	9.5	77	71	74	64	62	63
28 Day T&H	5	1	8.0	54	54	54	62	62	62
Jolt*	3	1	9.0	81	81	81	70	70	70
Transportation Vibration	4	3	10.0	82	72	75	64	62	63
Jumble*	4	0	---	--	--	--	--	--	--
40 Foot Drop*	3	0	---	--	--	--	--	--	--

*Unit is not required to function.

TABLE 2

STATIC BURNING TESTS OF REDESIGNED UNITS

Type of Conditioning	No. of Units Tested	No. of Units Functioning	Average Delay Time (Seconds)	Burning Time (Sec.) Smoke Max.	Smoke Min.	Smoke Avg.	Flare Max.	Flare Min.	Flare Avg.
Ambient Temp.	5	5	13	59	53	55	66	62	63
28 Day T&H Cycle	5	1	12	34	34	34	65	65	65
Jolt*	3	3	12	65	51	58	65	61	59
Transportation Vibration	4	4	12	66	42	58	64	59	63
Jumble*	4	4	11	59	46	53	63	58	60
40 Foot Drop*	3	3	11	65	61	63	62	61	62
+27°F (24 hours)	5	5	12	70	57	64	63	60	62
+100°F (24 hours)	5	5	11	64	57	61	61	58	60

*Unit is not required to function.

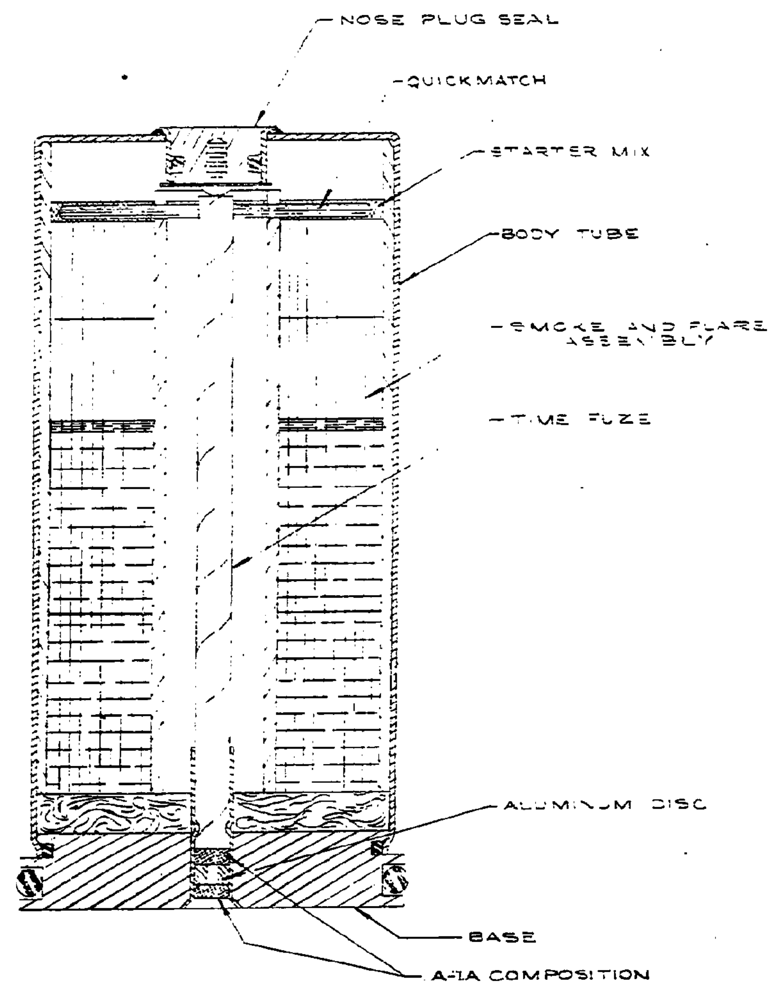

FIG. I
ORIGINAL DESIGN

EX-33 MARINE LOCATION MARKER

U. S. NAVAL AMMUNITION DEPOT CRANE, IND.
RESEARCH & DEVELOPMENT DEPARTMENT

R & D DRAWING NO. RDC-2-391

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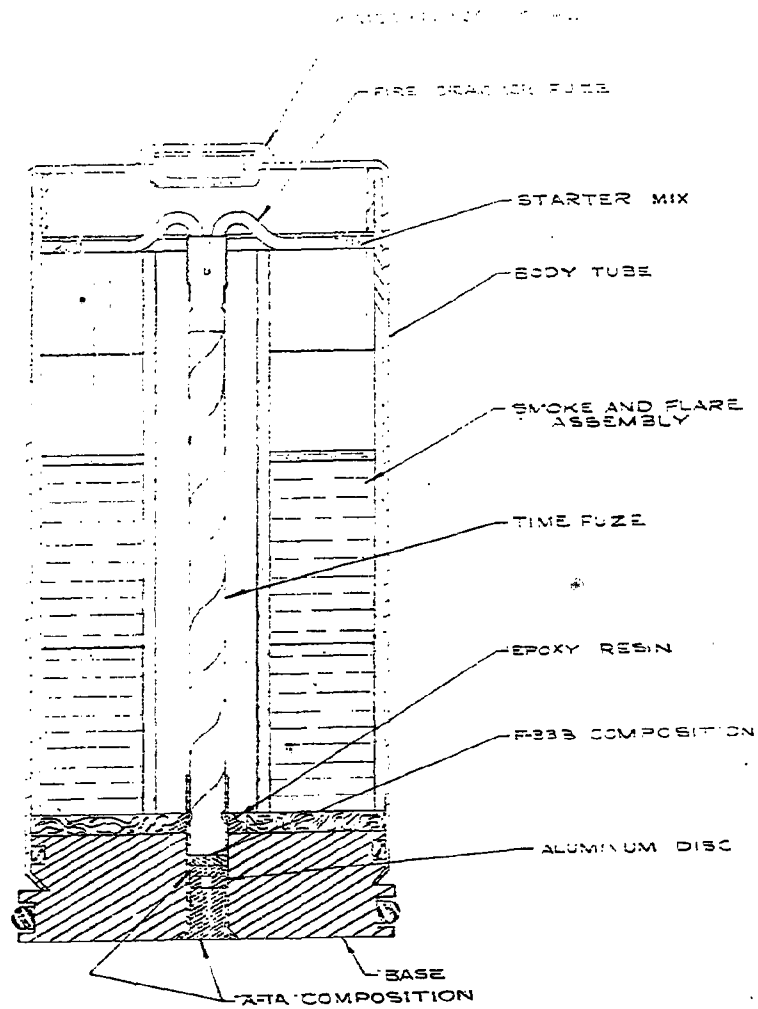


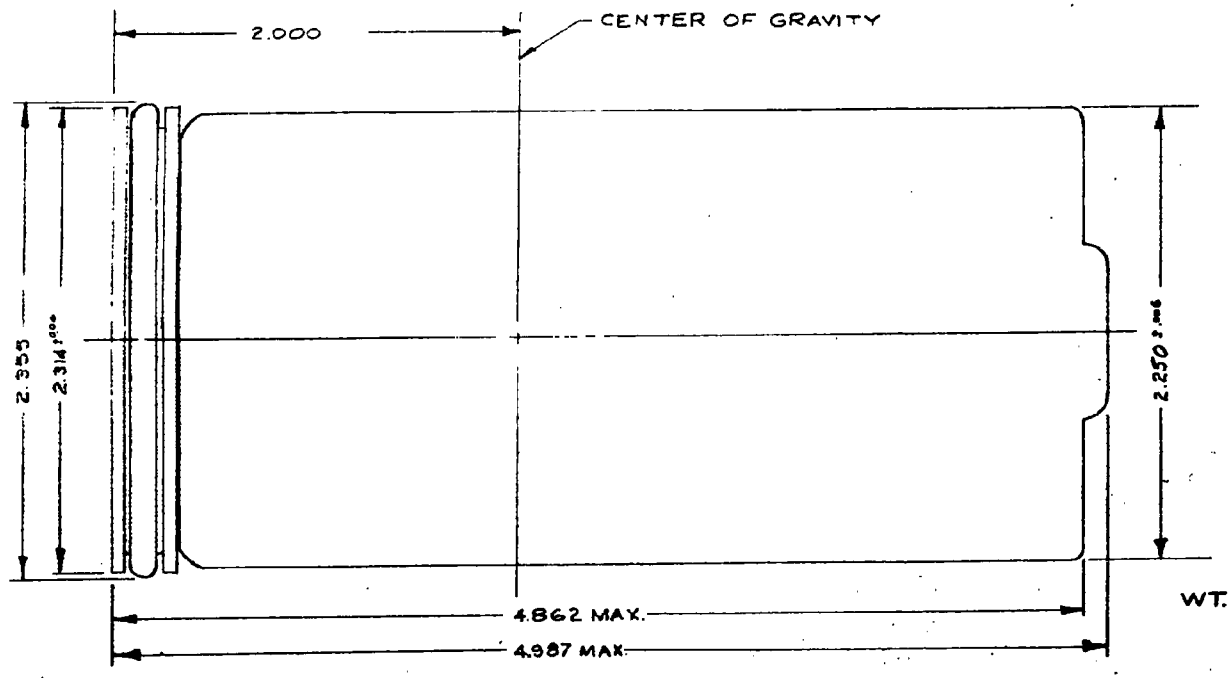
FIG. II
FINAL DESIGN

RDC-2-391

REVISIONS	
UNLESS OTHERWISE SPECIFIED REMOVE ALL BURRS AND SHARP EDGES DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS ± DECIMALS ± ANGLES ± DO NOT SCALE THIS DRAWING MATERIAL SPECIFICATIONS OF LATEST ISSUE APPLY	R & D APPROVAL / DATE APPROVED
EX-33 MARINE LOCATION MARKER ASSEMBLY	SCALE 2/1
U. S. NAVAL AMMUNITION DEPOT CRANE, IND. RESEARCH & DEVELOPMENT DEPARTMENT	R & D DRAWING NO. RDC-2-391

FIG III
GENERAL CONFIGURATION

RDC-2-392



PAGE 11

REVISIONS			
LTR	DESCRIPTION	DATE	

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DIMENSIONS ARE IN INCHES
TOLERANCE ON FRACTIONS ±
DECIMALS ± ——— ANGLES ± ~~
DO NOT SCALE THIS DRAWING
MATERIAL
SPECIFICATIONS OF LATEST ISSUE APPLY

R & D APPROVAL		DATE
DESIGNED		
DRAWN BY		
CHECKED BY		
ISSUED BY	TDH	7/6/61
APPROVED:		
DIRECTOR		

EX-33 MARINE LOCATION MARKER

OUTLINE

SCALE	SHEET NUMBER	
2/1		

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CRANE, IND.
RESEARCH & DEVELOPMENT DEPARTMENT

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14 September 1961, 12p, Task NOME 3E 000/323 1/F008-12-001

Task Engineer - R. W. Szypulski
Project Engineer - J. K. Boulotte and E. H. Mason, NAD Crane

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I. Marine Location Marker
II. Drill Limpet

I. Title
II. E. H. Mason
III. NAVWEPS Report 5487

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FOR ERRATA

AD 264 279

THE FOLLOWING PAGES ARE CHANGES

TO BASIC DOCUMENT

AD-264 279

Report number is corrected to read NAVWEPS-8246

264 279

END CHANGE PAGES